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PROMOTION TO THE RATE OF CHIEF AVIATION MACHINIST'S MATE UNITED STATES NAVY

WALTER J. EAST

Thesis
E14

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PROMOTION TO THE RATE OF
CHIEF AVIATION MACHINIST'S MATE
UNITED STATES NAVY

A THESIS
SUBMITTED TO THE
SCHOOL OF EDUCATION AND
THE COMMITTEE ON GRADUATE STUDY
OF
LELAND STANFORD JUNIOR UNIVERSITY
IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS
FOR THE DEGREE
OF
MASTER OF ARTS

By
Walter J. East
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E14

PREFACE

This thesis is an analysis of the procedures for promotion of enlisted personnel of the United States Navy. It was undertaken to help determine whether the Navy is selecting the best qualified men for advancement in rating. Although investigation was limited to the specific area of promotions to the rate of chief aviation machinist's mate, the results may be applied in a general way to the entire field of advancements to chief petty officer rates. The elements of the promotion system are common to all ratings.

This analysis of the Navy promotion system was confined to the mathematical efficiency of the system when it is used as a personnel selection tool. The effect of promotions on the morale of the enlisted men of the Navy was omitted - not because it was thought to be unimportant - but, on the contrary, because it was considered that the effect on morale was of at least equal importance and should be the subject of a separate study.

During preparation of this thesis, a number of persons gave liberally of their assistance and advice. I am indebted to many of the officers and men of Naval Air Transport Squadron Forty-Four for their cooperation which made the study possible. Foremost among them are the commanding officer, Captain James H. Mills, Jr., U.S. Navy, and Lieutenant William J. Scott, U.S. Navy, the Assistant Personnel Officer.

To my faculty advisor, Dr. James E. Curtis, Assistant Professor of Education, Stanford University, go my sincere thanks for generous devotion of his time and effort and for his valuable suggestions.

For helpful assistance in obtaining data for the study I am indebted to members of the staff of the Bureau of Naval Personnel, particularly Captain Charles E. McCombs, U.S. Navy, and Dr. Everett G. Brundage of the Research Division; Captain Ira E. Hobbs, U.S. Navy, Director of Enlisted Personnel; and Commander A. L. Gebelin, U.S. Navy, Head of the Enlisted Promotions Section. Lieutenant Colonel Bryghte D. Godbold, Office of the Director of Personnel, U.S. Marine Corps, also furnished valuable data and assistance.

I wish to thank Commander Willard Y. Howell, U.S. Navy, a classmate in the Naval Personnel Administration Course at Stanford, for reviewing and criticizing the original draft.

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CHAPTER I

THE PROBLEM AND ITS SCOPE

Statement of the Problem

In any organization, civilian or military, promotions are an important and continuing problem. In industry, labor and management have argued promotion for many years, with labor usually advocating promotion by straight seniority and management usually insisting on the right to promote according to its own judgment. Labor contends that promotion by management is too often promotion by favoritism, while management contends that promotion by seniority is unfair to the better men who must remain behind those with less competence but more seniority.

Although the Navy has no union problems, it does have a problem in the promotion of its enlisted men. The Navy recognized long ago that in order to build and maintain high morale it needed a system of enlisted promotions fair to all; a system based on "what you know" rather than "whom you know." To meet its needs, it developed a promotion system based primarily on professional qualifications but modified by length of service (seniority).

Advancements in rating in the Navy are made in order from a promotion list established by service-wide professional

examinations. Relative standings on the promotion list are determined by four factors: examination grade, weighted 73 per cent; total naval service, weighted 18 per cent; length of service in present rate, weighted 4.5 per cent; and awards for heroism and good conduct, weighted 4.5 per cent.

The problem centers primarily on the weightings given to these four factors. Many naval officers feel that the system gives too much weight to the pencil and paper professional examination and too little weight to seniority. There are those, however, who feel that the entire system is invalid and that it will not select the men best qualified for promotion, regardless of the weighting of the factors. The problem, then, can be reduced to three questions:

1. Does the Navy promotion system distinguish between the men who are qualified and those who are not?
2. Does the Navy promotion system establish the promotion list so that the best qualified men are advanced in rating first?
3. If the Navy promotion system does not now promote the best qualified men first, can the several factors affecting relative standing on the promotion list be re-weighted so that the best qualified men will be promoted first?

Need for the Study

During the war years the rapidly expanding Navy had a vacancy for every qualified man. The problem was not one

of selection of the best qualified but, rather, one of training. The wartime rating structure provided for very narrow specialization allowing rapid training and rapid advancement.

The situation is now changed. The postwar rating structure, requiring broad qualifications, is in effect. Although the Navy is below its authorized peacetime strength, its size is decreasing and will probably continue to do so. Vacancies in the higher petty officer brackets are becoming fewer and the number of candidates for these vacancies is increasing. The problem has become one of personnel selection and the promotion system must be tested to determine whether it is capable of picking out the best men. If the system does not do an acceptable job of selection it is fair neither to the men to whom it is applied nor to the service as a whole.

Limitations of the Study

The Navy promotion system encompasses sixty-two occupational groups (ratings). Lack of time and facilities necessitated limiting this study to a single rating, that of aviation machinist's mate. This rating was chosen because: (1) personnel in the rating were readily available for study, (2) representative duties of the rating are performed both ashore and afloat and, (3) there are few vacancies for advancement to chief petty officer in the rating.

The study was further limited to the rate of chief aviation machinist's mate for the reason that advancement to the

chief petty officer grade is more comparable to promotion to the supervisory level in industry than are advancements to other Navy grades. Promotion to petty officer third, second, and first class correspond more nearly to "upgrading" in industry.

The method of research required that the study be confined to personnel stationed in a single naval command. The chief aviation machinist's mates taking part in this study were all attached to Air Transport Squadron Forty-Four, Naval Air Station, Moffett Field, California.

Definitions[1]

By usage in the Navy, "advancement" is applied to increase in grade for enlisted personnel while "promotion" is applied to increase in grade for officers. The distinction will not be made in this study, however, and the two words will be used synonomously.

A "rating" is a name given to an occupation which requires basically related aptitudes, training, experience, knowledge and skills. "Aviation machinist's mate" is a rating.

A "pay grade" is a subdivision of a rating for pay purposes. A rating normally is composed of four pay grades: chief petty officer; petty officer, first class; petty officer, second class; and petty officer, third class.

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1. Bureau of Naval Personnel Manual, p. 144.

A "rate" identifies personnel by both occupation and pay grade. Thus, "chief aviation machinist's mate" is a rate.

The Manual of Qualifications for Advancement in Rating[1] defines the duties of aviation machinist's mates as:

> Aviation machinist's mates maintain, repair, test, inspect, adjust, and install aircraft engines (reciprocating and turbine) and accessories, including propellers, carburetors, pumps, oil coolers, and associated equipment. Operate engines and auxiliary power plants for operational or test purposes as may be appropriate.

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1. NavPers 18068. Washington: United States Government Printing Office, 1947, p. IX-1.

CHAPTER II

THE NAVY PROMOTION SYSTEM

Purpose of the Navy Promotion System

The Navy promotion system for enlisted personnel was built around three fundamental principles:

1. Only those fully qualified to hold a higher rate should be advanced.

2. Each man should have recurring opportunities to compete with others in his rate for advancement.

3. The best qualified men should be advanced first.

In regard to the first principle, the Bureau of Naval Personnel Manual[1] states:

> Personnel should be advanced in rating only if and when they are in all respects qualified to hold the higher rate to which advancement is to be effected. Advancements should not be made in the nature of rewards for faithful or extended service or simply because the minimum service requirements have been fulfilled, without regard to the actual qualifications of the individual. It is poor personnel administration to advance a person . . . . to a position which he is not qualified to fill.

The Head of the Enlisted Promotions Section, Bureau of Naval Personnel,[2] expressed the same idea in somewhat different terms:

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[1] Op. cit., p. 144.

[2] A. L. Gebelin, "Promotions, Examinations and Changes in Rate and Rating of Enlisted Personnel, USN," p. 1.

> Inasmuch as only well qualified individuals can be depended upon to carry out their assigned duties, advancement must only be conferred upon those who have proved themselves capable of carrying out the tasks assigned the duties of the higher grade. Advancement should not be conferred upon those who are either definitely not qualified to assume higher duties or upon those whose qualification is questionable.

The second and third principles were published in Bureau of Naval Personnel Circular Letter No. 155-48 which states:[1]

> These instructions are designed to provide a controlled system by which each and every enlisted person will have recurrent opportunities to compete for advancement in the individual's chosen field of work . . . . The determining factor in advancing eligible candidates is the relative qualification of each candidate.

Steps in Promotion[2]

For advancement to a higher rate every Navy man must complete these eight basic steps to promotion:

1. Meet certain requirements as to length of service.

2. Meet certain requirements as to marks in conduct and in proficiency in rate.

3. Complete satisfactorily the Navy training course for the next higher rate, when a suitable course is available.

4. Complete satisfactorily a course of instruction at a service school, when such is required.

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[1] "Advancement in Rating - Enlisted Personnel." BuPers Circular Letter No. 155-48, August, 1948.

[2] Bureau of Naval Personnel Manual, p. 143.

5. Qualify fully in the practical factors prescribed for the next higher rate.

6. Be considered by senior petty officers and officers as capable of performing the duties of the next higher rate and be recommended for advancement by the commanding officer.

7. Pass satisfactorily an examination in the subject "Military Requirements for all Men in the Navy."

8. Pass satisfactorily a professional examination based on requirements of the next higher rate.

Promotion to Chief Aviation Machinist's Mate

In order to clarify the eight steps in the Navy promotion system, they will be discussed as they apply specifically to promotion from the rate of aviation machinist's mate, first class, to chief aviation machinist's mate. The requirements for length of service, marks in proficiency in rate, and marks in conduct are common to all Navy ratings for advancement to chief petty officer.

Step 1. Length of Service. To be eligible for advancement to chief petty officer, a man must have had at least three years' service as a first class petty officer, six months of which must have been sea duty. No total naval service has been specifically prescribed but in order to be advanced to petty officer first class under present regulations,[1] a man must have served in the Navy a total

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[1] "Advancement in Rating - Enlisted Personnel," BuPers Circular Letter No. 155-48, August, 1948.

of three years. Therefore, for practical purposes, the minimum service requirements for advancement to chief petty officer are: six years' total naval service, the last three of which must have been served as a first class petty officer.

Step 2. Marks Requirements. Enlisted men are assigned marks quarterly in proficiency in rate and in conduct. Proficiency in rate is intended to denote ability, habits, character, and over-all value to the service in the particular rate.[1] Marks are assigned by division officers on a scale of 0 to 4.0 and are subject to approval by the executive officer acting for the commanding officer.

To be eligible for advancement to chief petty officer, a man must have received the following marks: in proficiency in rate, no mark less than 3.0 for the preceding two years and an average of not less than 3.5 for the three years preceding advancement; in conduct, no mark less than 3.0 and an average of not less than 3.5 for the two years preceding advancement.

The interpretations of these marks are:[2]

Proficiency in rate

4.0 - Competent, thoroughly reliable, attentive, energetic, forceful. Not less than 3.5 in conduct.

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[1] *Bureau of Naval Personnel Manual*, p. 181.

[2] *Ibid.*, p. 183.

3.5 - Competent and qualified in all duties of rate; has qualities sufficient to justify advancement. Not less than 3.5 in conduct.

3.0 - Competent and reliable in duties of billet of appropriate rate. Not less than 3.0 in conduct.

Conduct

4.0 - No offenses; exemplary in conduct, bearing, and uniform; good influence on the ship.

3.5 - Conduct positively good; no leave-breaking offense; not more than one minor offense in sobriety or of other nature.

3.0 - Minor offenses only, including one leave-breaking of less than 3 hours.

When a mark less than 4.0 in conduct is assigned, an explanation must be entered in the service record. Conversely, the conduct mark must agree with the disciplinary entries in the record of the same period.

The marks in proficiency in rate, however, are not handled in a similarly objective manner. It is common practice to assign all chief and first class petty officers marks of 3.9 or 4.0 in proficiency in rate, regardless of actual service worth, so long as no disciplinary offenses have been committed during the marking period.

The service records of fifteen chief aviation machinist's mates were examined to determine the correlation between quarterly marks and other ratings made by division officers. In total, the records of the fifteen men contained over one hundred quarterly marks. With two exceptions, every mark

was 4.0 - the two exceptions being a 3.8 and a 3.9 assigned to the same man in 1947. Since that time, however, all his marks had been 4.0 in spite of the fact that his division officer, three rating officers, the personnel officer, and the commanding officer declared him to be incompetent, of poor character, and of doubtful service worth.

In his study of enlisted men's quarterly marks, Godbold[1] stated: "If a chief or first class petty officer has been assigned a mark of 3.6 to 3.7 for a period in which he has violated no regulations, he is apt to consider this as an unsatisfactory mark."

It appears that the marks requirements for proficiency in rate do not contribute to the Navy promotion system, nor do they block the unqualified man from advancement so long as his conduct record is acceptable.

Step 3. Navy Training Courses. It is the stated policy of the Navy Department to provide, insofar as is practical, a training course for each rate.[2] In addition, the Department publishes "subject area courses" which include subject matter based on knowledge and skills which are required by more than one rating. If a training course has been published for the rate to which a man wishes to advance, he must complete

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[1] B. D. Godbold, "Measurement and Evaluation of Enlisted Men in the U.S. Navy," p. 31. Unpublished Master's thesis, Stanford University, California, 1947.

[2] Bureau of Naval Personnel Manual, p. 292.

it successfully before being considered eligible for promotion. Successful completion of a training course is determined by examination.

In April, 1948, the Navy placed a new postwar rating structure in effect which did away with some of the old ratings, created several new ones, and changed the duties of many of the ratings which were retained. As a result, new training courses are not yet available for many ratings, including that of aviation machinist's mate.

Aviation machinist's mates, first class, are not, therefore, required to complete a training course to be eligible for advancement but they are expected to complete pertinent parts of the following subject area courses:[1]

Aircraft Electrical Systems, NavPers 10315
Aircraft Hydraulic Equipment, NavPers 10332
Aircraft Engines, NavPers 10334
Aircraft Fuel Systems, NavPers 10335
Aircraft Propellers, NavPers 10336
Flight Engineering, NavPers 10395

In addition, aviation machinist's mates, like all candidates for advancement to the chief petty officer grade, must have completed the "General Training Course for Petty Officers 1c and Chief Petty Officers."

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[1] "Training Publications Available for the Postwar Enlisted Rating Structure." BuPers Circular Letter No. 6-48, January, 1948.

Step 4. Service Schools. Advancement to certain rates requires successful completion of a prescribed course at a Navy service school. While there is an aviation machinist's mates' school, completion of its course is not mandatory for advancement in the rating.

Step 5. Practical Factors. "Practical factors are those qualifications which are best determined by observation of the candidate in situations that require a demonstration of his knowledge, skill, and ability under actual or simulated working conditions."[1] Practical factors are included under both the military and the professional requirements for advancement in rating.

The practical factors under military requirements for promotion to chief petty officer rates are basically the same for all ratings. They include such items as leadership, division duties, instruction of personnel by on-the-job training methods, infantry drill, sentry duties, and ship and aircraft recognition.

Practical factors under professional qualifications for promotion to chief aviation machinist's mate are assigned in the following areas:[2]

Use of hand and power-driven tools.

Use of measuring instruments.

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1. Manual of Qualifications for Advancement in Rating, NavPers 18068, p. iv.

2. Ibid., pp. IX-1 - IX-4.

Blueprint reading.

Airplane handling and servicing.

Aircraft engine installation, maintenance, and overhaul.

Propeller installation, service, and repair.

Carburetor maintenance and repair.

Instrument and accessory repair and service.

Flight engineering.

Safety precautions.

Records and reports applicable to aircraft engine operation, service, and repair.

Supervision and training of personnel.

Practical factors are non-competitive, and no marks are assigned, but the service record of the candidate must show that he has completed the practical factors for the next higher rate before he is eligible to take the professional examination for promotion.

Careful administration of the practical factor requirements would strengthen the promotion system by motivating candidates for advancement to learn, and by weeding out some of the obviously unqualified men. In practice, however, the administration of practical factors is generally lax. The feeling seems to be that holding a petty officer rate is conclusive evidence that a man is qualified in all the practical factors of the rating. This feeling is especially true toward the higher petty officer grades.

Item 6. Recommendation by the Commanding Officer.

In connection with the recommendation by the commanding officer, Gebelin[1] states:

> Prior to becoming eligible for advancement in rating an individual is required to be recommended for that higher rate by his commanding officer. Naturally the commanding officer must take the recommendation of officers and petty officers immediately over the individual concerned. Irrespective of having met all other eligibility requirements an individual who is not considered by competent authority to be able to perform the duties of the higher rate, if successful in examination, should not be recommended by his commanding officer until such time as he is considered qualified.

At first glance this appears to be a statement of sound policy; actually, it is inconsistent. If a candidate for advancement to chief aviation machinist's mate has "met all other eligibility requirements," his quarterly marks must have averaged 3.5 for the past three years. A mark of 3.5 in proficiency in rate means, "competent and qualified in all duties of rate; has qualities sufficient to justify advancement." To deny a man, otherwise eligible, the opportunity to compete for advancement by withholding his recommendation places the commanding officer in an untenable position. Even though it is widely recognized that quarterly marks do not reflect true estimates of abilities, commanding officers feel bound by them and rarely, if ever, withhold their recommendations.

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[1] Gebelin, op. cit., pp. 3-4.

Step 7. Examination in Military Requirements. In conjunction with the professional examination, all candidates for advancement to chief petty officer rates are given a written examination based on the "General Training Course for Petty Officers 1c and Chief Petty Officers." Although the examination is non-competitive, each candidate must make a score of at least 2.5 based on a scale of 0 to 4.0.

The examination is objective, consisting of multiple choice questions in such areas as military etiquette, seamanship, safety precautions, fire fighting, security and accountability of classified matter and government property, and general aviation information. The military requirements examination is not difficult; men who have studied the training course usually have no difficulty in passing it.

Step 8. Professional Examination. The final step in the promotion ladder is the written professional examination. For advancement to chief petty officer rates, the examinations are service-wide and competitive. Other factors being equal, the man making the highest score on the examination will be advanced first. Only those scoring 2.5 or higher are considered for advancement.

The Manual of Qualifications for Advancement in Rating[1] prescribes in detail the subjects to be covered by the professional examination for each Navy rate. Candidates for

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[1] Op. cit., pp. IX-4 - IX-6.

advancement to chief aviation machinist's mate are examined in the following general areas:

Tools and measuring instruments.

Airplane handling and checking.

Aircraft engines.

Aircraft propellers.

Carburetors and fuel systems.

Instruments and accessories.

Mathematics.

Aircraft construction.

Flight operations.

Safety precautions.

Records and reports.

Publications.

Aviation organization.

The professional examinations are constructed and distributed by the Bureau of Naval Personnel. The completed examinations are returned to the Bureau for grading and computation of multiple scores.[a] The Chief of Naval Personnel authorizes advancement of the men having the highest multiple scores to fill actual and expected vacancies. At present, professional examinations are held annually.

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[a] Multiple scores consist of professional examination scores plus credits for total naval service, service in present rate, and awards for heroism and good conduct. Multiple computation is explained in detail in Chapter VIII.

Areas of Investigation

Although the Navy promotion system consists of eight steps, it appears that only two of them have any real effect in determining the qualifications of the candidates and their standing on the promotion list. The two significant steps are: length of service, including total service and service in rate; and score on the professional examination.

The only other significant item in the promotion system is the high standard of conduct. Bad conduct, even though the offenses are relatively minor, will block a man's promotion.

In order to study the Navy promotion system as it actually operates, the areas of investigation may be limited to total naval service, service in present rate, awards, and the professional examination. This study was so limited, except that some investigation was made in the area of Navy test battery scores and their relationship to professional examination grades and promotability.

Related Studies

The most recent study in the field of enlisted military promotions was made by Godbold[1] for the United States Marine Corps. At present, staff noncommissioned officers of the

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1. B. D. Godbold, "Recommendations for Changes in Procedures for Promotion to Staff Noncommissioned Officer Grades." Unpublished memorandum to the Director of Personnel, U.S. Marine Corps, Arlington, Va., February 15, 1950.

Marine Corps are selected for promotion by a board of officers in the Corps Headquarters. The board considers the records of marines eligible for promotion in order of seniority, rejecting those not considered qualified. Selections are made from the seniority list until vacancies are filled or until all eligible candidates have been considered.

In lieu of considering the marines candidates in order of their seniority, Godbold recommended that they be considered in order of a composite score computed from merit ratings, score on a General Military Subjects test, time in grade, and time in service. He further recommended that these elements be weighted: merit ratings, 48 per cent; General Military Subjects test, 24 per cent; time in grade, 24 per cent; and time in service, 4 per cent.

The weights recommended for the elements in the composite score were based on the following:[1]

> The most heavily weighted element is to be the average Fitness Report Score computed from Fitness Reports subsequent to last promotion. Approximately half of the total score will be contributed by Fitness Reports. This heavy weighting is justified on the grounds that past performance over an extended period of time is the best indication of probable future performance. This can be thought of as reflecting largely performance in his specialty.
>
> The GMST is to receive half the weight of the average Fitness Report score. The weight given this test is justified on the grounds of its being based on a standardized test measuring knowledge of those military subjects prescribed for all marines of that grade. This can be thought of as reflecting

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[1] Ibid., pp. 4-5.

> his knowledge of those general subjects which make the man an "all-round" marine.
>
> Time in grade will also receive half the weight of the average Fitness Report score. The weight given this element is justified on the grounds that experience in grade contributes toward qualification for higher grade.
>
> Time in service will receive a small weight, about one-sixth of time in grade. This weight is justified on the grounds that some qualifications are gained during service in lower grades, but primarily because it is believed that long service should receive some reward.

Industrial promotion systems and their operation are not directly applicable to the Navy. Advancements in industry from worker to supervisory levels are usually made within departments. No large corporation in the United States promotes its men on a world-wide basis as does the Navy--which has men serving in China, the United States, and Europe competing with each other for advancement to the same vacancies.

However, there have been many significant studies made in industry concerning the attitudes of workers toward promotion in relation to job satisfaction. Almost without exception, worker attitude surveys find that opportunity for advancement and promotion-on-merit rank high among those things which men want in their jobs. In an extensive study of one hundred thousand employees of large corporations it was found that "certainty of promotions going to best qualified employees" was among twelve items important to job satisfaction.[1]

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[1] George W. Hartmann and Theodore Newcombe, (Editors), Industrial Conflict, "Work Satisfaction," by Goodwin Watson, New York: The Cordon Company, 1939, p. 118.

Because naval personnel are on the average quite young (most chief petty officers are eligible for retirement at age forty), it is significant to note that younger workers in industry generally put more emphasis on promotions in connection with job satisfaction than do the older workers.

In studying factors related to morale among department store workers Kolstad[1] found that "promotion of best qualified persons" was one of the items most closely related to morale.

Insofar as can be determined, there have been no scientific validation studies of the Navy promotion system since it was placed in effect after World War II. The Marine Corps is studying its system, which places heavy emphasis on seniority, with a view to giving more weight to pencil and paper tests and efficiency ratings. Unlike the Navy, the Marine Corps has an effective rating system for its enlisted personnel in the higher grades. In industry, the pertinent related studies have clearly shown the importance of promotions to morale and job satisfaction.

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1. A. Kolstad, "Employee Attitudes in a Department Store," Journal of Applied Psychology, 22: 470-479, (1938).

CHAPTER III

THE METHOD OF INVESTIGATION

The Approach to the Problem

The primary consideration in selecting the method of research was that, within the limits of time and facilities available, the method selected should provide significant information relative to the questions previously decided to be basic to the problem:

1. Does the Navy promotion system distinguish between men who are qualified and those who are not?
2. Does the Navy promotion system establish the promotion list so that the best qualified men are advanced in rating first?
3. If the Navy promotion system does not now promote the best qualified men first, can the several factors affecting relative standing on the promotion list be re-weighted so that the best qualified men will be promoted first?

After preliminary surveys to determine the largest possible sample, a group of fifteen chief aviation machinist's mates was selected. Three officers considered qualified to evaluate the job performance and promotability of the men were chosen as judges. Using a combination of rating and ranking methods, the judges established the order in which

the men should be promoted. The men were given a professional examination for promotion and the scores were combined with length of service, service in rate, and awards, to determine the order in which the Navy promotion system would have advanced them in rating. Each of the factors contributing to the multiple score was analysed to determine the individual effects upon the final relative standings.

The use of chief petty officers rather than first class petty officers is analagous to the common practice in industry of using workers already on the job rather than applicants to validate selection procedures. The advantage is that the length of time required for the validation study is shortened considerably. The primary disadvantage is that it violates the principle that a validation study should be performed on a group representative of the population on which the tests are intended to be used. This weakness is not fatal, however. On the contrary, in the initial study it may be good practice since the coefficients of correlation found by using personnel on the job will probably be lower than if a group of applicants were used. Ghiselli and Brown[1] state:

> It is not to be presumed, however, that little information is gained from a validation study on old-established workers. On the contrary, it is almost certain that if a test stands up under this type of validation, it will have even more predictive power than indicated by this group when it is used with a group of applicants.

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[1] Edwin E. Ghiselli and Clarence W. Brown, Personnel and Industrial Psychology, p. 173.

Selection of the Criterion

In order to ascertain whether the best qualified men were advanced in rating in their relative order of qualifications by the Navy promotion system, it was first necessary to select a measure by which the relative qualifications of the men could be determined. Preferably such a measure, or criterion, should be objective. Unfortunately, in this study it was found necessary to use officer ratings as a criterion measure after considerable research indicated that no other measure of ability and promotability seemed to be practical.

The primary difficulty in selecting an objective measure of success on the job was the lack of an accurate job description for the rate of chief aviation machinist's mate. Those published by the Navy Department were unacceptable for the reason that they over-emphasized technical proficiency. The definition of the aviation machinist's mate rating quoted on page 5 is an example. It is an accepted view in the Navy that a chief petty officer's primary duty is supervision and that he requires technical knowledge only to the extent necessary for him to intelligently supervise and instruct others. "A petty officer must be first a leader and second a specialist."[1]

Actually, the Navy does not yet know exactly what is required of the various rates. The Head of the Billet and

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[1] _Special Aids for Placing Naval Personnel in Civilian Jobs_, p. vi.

Qualifications Research Branch, Bureau of Naval Personnel[1] stated:

> . . . . as some have said, a man has to be a superman in some ratings to qualify for chief. This problem results from our inability up to the present to make scientific research studies into each of the individual ratings and validate our paths of advancement. This we are working on within our budgetary limitations.

Thus, in spite of the known unreliability of rating methods, merit ratings of the subjects were chosen as the criterion. "Success in a job is dependent not only upon how well the individual performs his work, but also upon the attitude of his superiors toward him and his work. The truth of the matter is that the latter is probably the best criterion of success from a practical point of view, for the superior determines whether the man continues on his job or is discharged."[2]

Selection of the Judges and Subjects

An original panel of twelve officer judges was selected by the commanding officer of the squadron. The bases of selection were that the officers must have been on board the squadron for at least one year and that they must have been performing duties which would have brought them into frequent

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1. D. G. Price, "Present Philosophy of the Rating Structure." Paper read before the Board to Review Changes to the Rating Structure, Arlington, Va., April 20, 1949.

2. Edward K. Strong, Jr., Psychological Aspects of Business, p. 449.

official contact with many of the aviation machinist's mates in the squadron. In addition to meeting these requirements, all of the officers chosen were of very high calibre.

Each of the officers was given a list of the 119 chief aviation machinist's mates attached to the squadron and asked to indicate those whom he had observed sufficiently to rate on performance of duty. It was expected that about nine of the officers would be able to rate thirty of the men in common. Unfortunately, it was found that only nine of the officers could rate a total of sixteen or more men each; of the 119 possible subjects, only twenty could be rated by two or more officers; and only fifteen could be rated by three officers in common.

The final determination of the size of the sample, the men included in it, and the judges, was limited by the number of men known in common by the officers. The sample could have been increased to seventeen if only two judges had been used, and to thirty-two if only one judge had been used. It was felt that the use of three judges and fifteen men was preferable.

Due to the method of selection, the subjects did not constitute a representative sample of the chief aviation machinist's mates in the squadron. It is believed that the sample, with the exception of one man, was composed of the better-than-average chiefs. It is thought that the men were known by the officers because of their ability and because

they held important jobs. The one exception strengthens this belief. The man appears to have been well known for his outstanding lack of ability and poor reputation.

CHAPTER IV

THE CRITERION

Establishing the Criterion

The criterion was established by a combination of rating and ranking methods. The procedure used was developed from Bingham's[1] suggestion that the reliability of over-all ratings would be increased if the rater first rated on specific traits.

The judges first rated the men using a Petty Officer Rating Scale developed by the Bureau of Naval Personnel. The scale is designed so that fifteen men may be rated on fourteen traits on one rating blank. The men being rated are marked together on one trait at a time. The fourteen traits are divided into three areas so that the final products of the scale are ratings in productivity, technical proficiency, and leadership.

The Petty Officer Rating Scale ratings were not actually used in establishing the final rank order of the men. The scale is experimental and has not yet been thoroughly tested by the Navy Department. The primary purpose in its use was to encourage the judges to think of the men in terms of specific traits before deciding on their promotability.

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[1] W. V. Bingham, "Halo, Invalid and Valid," Journal of Applied Psychology, Vol. 26, pp. 468-476, 1942.

Immediately after completing the rating scales, the judges ranked the men in the order in which they should be promoted. The basis for the ranking was defined as performance of duty as chief petty officers, with seniority taken into account if the judges considered length of service to be important to promotability.

The ranking was done by the method of comparative arrangement described by Goodenough and Anderson.[1] Each judge was given a name card for each of the men to be ranked. Two cards were chosen at random from the set and arranged so that the card of the man deserving promotion first was to the right. The other cards were then drawn singly and placed in their proper positions in relation to the others.

The criterion was established by combining the rank orders of the three judges. As recommended by Guilford,[2] median ranks rather than average ranks were used to determine the final rank order. The men were first tentatively assigned the mid-most rank given by the judges. In the cases wherein two men received the same median rank, the man with the lowest average rank was given the higher standing in the pair.

The ranks assigned to the fifteen subjects by each of the three judges, the median ranks, and the final ranks are shown in Table I. The final rank order in column four of

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[1] Florence L. Goodenough and John E. Anderson, Experimental Child Study, pp. 413-418.

[2] J. P. Guilford, Psychometric Methods, pp. 276-277.

of the table was used as the criterion of relative order of promotability of the men.

TABLE I

RANKS ASSIGNED BY JUDGES, MEDIAN RANKS, AND FINAL RANK ORDER ESTABLISHING CRITERION

1	2			3	4
Men Ranked	Rankings			Median Rank	Final Rank Order
	Judge I	Judge II	Judge III		
A	1	1	8	1	1
B	12	3	2	3	2
C	4	2	5	4	3
D	9	5	3	5	4
E	2	6	6	6	5
F	6	4	12	6	6
G	11	7	1	7	7
H	3	13	7	7	8
I	8	9	4	8	9
J	7	8	11	8	10
K	10	10	10	10	11
L	14	12	9	12	12
M	13	11	13	13	13
N	5	14	14	14	14
O	15	15	15	15	15

Reliability of the Criterion

Assuming that the judges were equally competent as raters, that they knew the capabilities of the men equally well, and that they were judging promotability on the same basis, the reliability, or internal consistency, of the criterion could be measured by the intercorrelations of the three sets of ranks. Table II shows the correlations between the judges and their average rank differences. The average correlation between judges was +.36, indicating a rather low order of agreement among them.

TABLE II

INTERCORRELATIONS OF RANK ORDERS ASSIGNED BY THREE JUDGES

Judges	Correlation	Average Rank Difference
I-II	+ .41	3.3
I-III	+ .12	4.7
II-III	+ .56	3.0

However, the most that should be expected from rating or ranking systems in their present stage of development is that they will identify three groups, the high merit group, the group of average merit, and the low merit group. Taking this view, the agreement among judges was somewhat better. A study of Table III, page 32, shows that the subjects may be divided into three sharply defined groups: a high group of six; a middle group of five; and a low group of four. These groups are separated by horizontal dotted lines in the table.

In the high group, chiefs A, B, C, D, E, and F were ranked sixth or better by at least two of the judges. These men received fourteen of the eighteen total ranks in the one to six range--an agreement among judges of 78 per cent. Similarly, chiefs G, H, I, J, and K received 73 per cent of the ranks in the seven to eleven range, and chiefs L, M, N,

and O received 75 per cent of the ranks in the twelve to fifteen range. The over-all agreement among judges as to the membership of the three groups was 75.6 per cent.

TABLE III

COMPARISON OF RANK ORDERS OF THREE JUDGES

Rank Order	Judge			Criterion
	I	II	III	
1	A	A	G	A
2	E	C	B	B
3	H	B	D	C
4	C	F	I	D
5	N	D	C	E
6	F	E	E	F
7	J	G	H	G
8	I	J	A	H
9	D	I	L	I
10	K	K	K	J
11	G	M	J	K
12	B	L	F	L
13	M	H	M	M
14	L	N	N	N
15	O	O	O	O

The assignment of ranks in the high and low ranges is shown graphically in Figure 1. Ranks in the high range, one to six, are plotted above the base line and ranks in the low range, twelve to fifteen, are plotted below it. The concentration of high and low ranks indicates that the judges were in fair agreement as to who were the better and the poorer men.

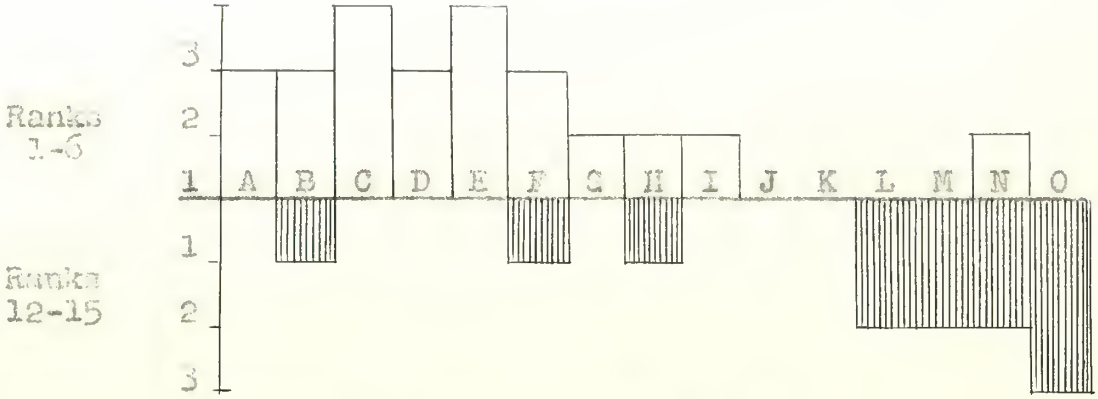

FIGURE 1. DISTRIBUTION OF JUDGES' RANKS IN HIGH AND LOW RANGES

Strong[1] states that the reliability of a rating report may be measured by correlating two sets of ratings by the same rater upon the same individuals with a sufficient interval of time intervening to eliminate the influence of immediate memory. This reasoning can be extended to include the correlation of two sets of pooled ratings.

Fifteen days after the first rating-ranking the judges repeated the procedure. The results of the second series of rankings is compared with the first in Table IV. The average of the rank differences between the first and second rankings was .93 and the rank order correlation between the two was ≠.94. The only significant change in rank order was that of Chief E who dropped from fifth to tenth place.

It is realized that some authorities would not accept this as a measure of the reliability of the criterion since it may show only that the judges were remarkably consistent

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1. Edward K. Strong, Jr., Psychological Aspects of Business, p. 447.

in their disagreement. It is also possible that fifteen days was not a sufficient interval to erase the effects of immediate memory.

TABLE IV

COMPARISON OF MEDIAN RANKINGS OF THREE JUDGES AFTER FIFTEEN DAY INTERVAL

Subject	First Rank	Second Rank	Rank Difference
A	1	1	0
B	2	2	0
C	3	3	0
D	4	4	0
E	5	10	5
F	6	5	1
G	7	6	1
H	8	7	1
I	9	8	1
J	10	9	1
K	11	11	0
L	12	13	1
M	13	14	1
N	14	12	2
O	15	15	0

The most accurate inference to be drawn from the data is probably that the criterion has low reliability if actual rank order is emphasized but that the criterion is fairly reliable if it is considered to consist of three classifications - high, middle, and low.

In summary, it was believed that the median ranks assigned by the three officers provided a reliable method for dividing the men into three groups in order of promotability. Hence

these rankings served as the criterion with which the order of promotion, as established by the Navy promotion system, was compared.

CHAPTER V

THE PROFESSIONAL EXAMINATION

Scope

In order that the Navy promotion system might be applied in a realistic manner, a professional examination for promotion to chief aviation machinist's mate was obtained from the Bureau of Naval Personnel. The examination was the one which had been used in the service-wide examinations in December, 1949. None of the chiefs used as subjects in this study had seen it previously nor had they heard any of the questions discussed.

The examination consisted of 150 multiple choice questions with four possible answers given for each question. It was administered in accordance with standard instructions[1] which specified a three hour time limit. However, none of the men required more than two hours.

The examination covered thirteen general areas: (1) tools and measuring instruments; (2) airplane handling and checking; (3) engines; (4) propellers; (5) carburetors and fuel systems; (6) instruments and accessories; (7) mathematics; (8) aircraft construction; (9) flight operations; (10) safety

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1. "Service-Wide Competitive Examinations for Advancement to Chief Petty Officer, Acting Appointment." BuPers Circular Letter No. 106-49, June, 1949.

precautions; (11) records and reports; (12) publications; and (13) aviation organization.

Since the examination is classified as confidential by the Navy Department it may not be included in this report. In order to show the general type of questions asked, however, three typical questions are reproduced below. The correct answers are indicated by "X."

> The instrument which shows the amount of fluid pressure developed in the gear system which operates aircraft landing gear is the
>
> (X) 1. hydraulic pressure gage
> 2. hydrostatic level gage
> 3. manifold pressure gage
> 4. gyrostatic pressure gage
>
> (All men answered correctly)
>
> The blade angle range of the Hamilton Quick Feathering Hydromatic propeller is determined by the settings of
>
> (X) 1. high and low pitch stop rings
> 2. position of assembly stop pins
> 3. high and low pitch stop plate
> 4. index pins
>
> (Eight men answered correctly)
>
> A nine cylinder radial engine having a power stroke of 120 degrees will have an overlap of
>
> 1. 20 degrees
> 2. 30 degrees
> (X) 3. 40 degrees
> 4. 60 degrees
>
> (One man answered correctly)

Examination Scores

The examination scores were computed on the usual Navy 0 to 4.0 scale using the formula:

$$\text{Score} = \frac{X \times 4.00}{N}$$

X = Number of questions answered correctly.

N = Total number of examination questions.

Table V lists the scores in order of criterion rank. They ranged from 2.11 to 2.91 which are equivalent to 79 and 109 correct answers respectively. The mean score was 2.55 (95.7 correct answers) and the standard deviation was .24 on the 4.0 scale, or 9.0 on a scale of 0 to 150.

TABLE V

COMPARISON OF RANK ORDER BY PROFESSIONAL EXAMINATION SCORES WITH CRITERION RANK ORDER

1 Subjects	2 Correct Answers	3 Score	4 Rank	5 Criterion Rank
A	98	2.61	7.5	1
B	109	2.91	1	2
C	107	2.85	3	3
D	95	2.53	9.5	4
E	98	2.61	7.5	5
F	101	2.69	5	6
G	108	2.88	2	7
H	85	2.27	13	8
I	82	2.19	14	9
J	79	2.11	15	10
K	88	2.35	12	11
L	100	2.67	6	12
M	95	2.53	9.5	13
N	102	2.72	4	14
O	89	2.37	11	15

Correlation with the Criterion

The rank order correlation between the examination scores and the criterion was +.38, which is low but usable in group

personnel selection. The correlation coefficient of .58 does not give the complete picture of the selectivity of the examination. In order to be eligible for advancement, a minimum score of 2.5 on the professional examination is required.[1] Table V reveals that only ten of the chiefs achieved the qualifying score and that all seven men above the median criterion rank of eight were among the qualifiers. Only three men at or below the median passed the examination. In other words, if the professional examination were the sole factor determining advancement, and if all those passing it were promoted, 70 per cent of the men advanced would have been above average as determined by the criterion.

In connection with the arbitrary passing grade of 2.5, however, it should not be overlooked that none of the chiefs had studied in preparation for the examination. It is possible that had they been given an opportunity for advance preparation, all the men would have passed.

Item Analysis of Examination Questions

There are three significant danger signals for any test item: (1) if all those tested give the correct answer to an item it may be too easy or it may be improperly constructed so that the correct answer is obvious; (2) if none of those tested give the correct answer the item may be too difficult or the scoring key may be in error; (3) if more men in the

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[1] Bureau of Naval Personnel Manual, p. 146.

low score group than in the high score group answer correctly it may be that the wording of one of the incorrect answers attracted the high score group away from the correct answer.

A comparison for each item was made between the five men making the highest examination scores and the five men making the lowest to determine which items actually discriminated between the two groups. A question was said to discriminate if more men in the high group than in the low group answered it correctly. It was found that:

(a) in 53 per cent of the items the high group answered correctly more often than the low;

(b) in 33 per cent of the items there was no difference in correct answers between the high and low groups; and

(c) in 14 per cent of the items the low group answered correctly more often than did the high group.

These results would seem to indicate that only eighty of the one-hundred and fifty questions were really effective in discriminating between the high and low scores; that forty-nine questions added nothing to the examination; and that twenty-one questions actually detracted from its effectiveness.

Whether or not an item discriminates between the high and low groups is important but it is not a complete measure of effectiveness since it does not necessarily indicate the

difficulty, or suitability of the item. Guilford[1] demonstrated that the validity of a test may be seriously influenced by its level of difficulty and laid down certain rules concerning the difficulty of test items:

> Here several accepted rules apply, rules that are wise on both theoretical and empirical grounds. Items passed by everybody or failed by everybody are of no value for measurement purposes. This rule may be violated for the sake of introducing one or two very easy "shock absorbers" at the beginning of a test. The maximum discrimination among testees is to be obtained by items that about one-half the individuals can pass. This rule implies proportions that have been corrected for chance success.

In applying these rules to the professional examination it was first necessary to correct the proportion passing each item for chance success. Since there were only four possible answers to each question it might be expected that any man having no idea which answer was the correct one would have one chance in four of guessing it. Therefore, it must be assumed that of the proportion passing an item a certain per cent succeeded by guessing. Table VI, which shows the uncorrected and corrected proportions used in establishing the basis for determining the level of difficulty of the individual test items, was adapted from Guilford.[2]

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[1] J. P. Guilford, Fundamental Statistics in Psychology and Education, p. 293.

[2] Ibid., p. 117.

TABLE VI

PROPORTION OF INDIVIDUALS PASSING A TEST ITEM WITH FOUR ALTERNATIVE ANSWERS CORRECTED FOR CHANCE SUCCESS

Number Passing	Proportion	Corrected Proportion
0	.00	.00
1	.07	.00
2	.13	.00
3	.20	.00
4	.27	.03
5	.33	.11
6	.40	.20
7	.47	.29
8	.53	.37
9	.60	.47
10	.67	.56
11	.73	.64
12	.80	.73
13	.87	.83
14	.93	.91
15	1.00	

Because of the small sample, wide latitude was used in selecting the items considered to be of the proper level of difficulty. Instead of setting the limits of the passing proportion near .50, an item was considered acceptable if the corrected passing proportion fell between approximately one-third and two-thirds. Referring to Table VI, this meant that, for practical purposes, corrected passing proportions between .29 and .64 were to be accepted. Applying this measure to the test items it was found that of the total items:

11 per cent were passed by a corrected proportion of .00 and were therefore useless;

20 per cent were passed by a proportion of .05 to .20 and may be considered too difficult;

27 per cent were within the acceptable limits of difficulty;

27 per cent were passed by a proportion of .64 to .91 and may be considered too easy; and

15 per cent were passed by all and were also useless.

These data would seem to indicate that only 27 per cent (41 questions) were actually "good." This is supported by the fact that if the examination is considered to have consisted of only the forty-one "good" questions, the rank order correlation between the scores computed on that basis and the criterion is +.35 which is not significantly different from the +.38 correlation of the entire examination. While these conclusions regarding the effectiveness of the items should be accepted with reservations because of the small number of testees, it appears, nevertheless, that valuable information would be obtained from an item analysis based on a larger sample. The necessary data are available to the Navy Department.

Reliability of Test Scores

The reliability coefficient of the test scores was computed by the split-half method using odd and even numbered test items. Rulon's[1] formula, which eliminates the necessity

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[1] P. J. Rulon, "A Simplified Procedure for Determining the Reliability of a Test by Split-halves," Harvard Educational Review, 1939, Vol. 9, pp. 99-103, as quoted by J. P. Guilford, Fundamental Statistics in Psychology and Education, pp. 275-276.

of correcting the split-half reliability for length of test, was applied and yielded a reliability coefficient of .70 which is barely acceptable.

Since the reliability coefficient is the square of the index of reliability, it may be considered to represent the proportion of true variance in the obtained scores. In this case, 70 per cent of the variance in the scores may be said to be "true variance" while 30 per cent of the variance is "error variance."

CHAPTER VI

LENGTH OF SERVICE

Total Naval Service

For advancement purposes, Navy men are credited with all active duty, both regular and reserve, up to a maximum of twenty years. Table VII gives the total naval service of the fifteen chief aviation machinist's mates studied. Only one man had more than twenty years' service and his excess was the insignificant amount of three months.

TABLE VII

COMPARISON OF RANK ORDER BY LENGTH OF SERVICE WITH CRITERION RANK ORDER

Subject	Total Naval Service in Years	Rank Order by Total Service	Criterion Rank
B	20.25	1	2
A	20.00	2	1
I	17.42	3	9
D	17.17	4	4
F	15.75	5	6
H	14.33	6	8
K	14.22	7	11
L	13.92	8	12
J	12.92	9	10
G	12.50	10	7
M	12.33	11	13
N	12.25	12	14
E	10.92	13	5
O	10.33	14	15
C	8.75	15	3

The average length of service shown in Table VII is 14.2 years which is higher than the twelve years' average length of service for all chief petty officers currently serving in the Navy.[1]

Correlation with the Criterion

Regardless of the fact that their own promotions are based on seniority to a large extent, and they would not have it otherwise, many officers in the Navy maintain that length of service should not be weighted heavily in enlisted advancements. The *Bureau of Naval Personnel Manual*, Gebelin, and Price all warn against promoting men on the basis of service.[2]

The fact is that length of service appears to have the highest correlation with promotability of any of the factors influencing promotion under the present system. Referring to Table VII, the rank order correlation between length of service and the criterion was +.46. The largest rank difference between length of service and the criterion was twelve in the case of Chief C. It happens that C's length of service does not accurately reflect his experience. Before enlisting in the Navy during the war he had six years' experience

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1. A. L. Gebelin, "Promotions, Examinations and Changes in Rate and Rating of Enlisted Personnel, USN," November, 1949. P. 9.

2. *Bureau of Naval Personnel Manual*, p. 144.
Gebelin, *op. cit.*, p. 2.
Price, *op. cit.*, p. 2.

as an airplane mechanic. If this six years is credited to him as naval service for promotion purposes, the correlation between length of service and the criterion increases to approximately +.69.

It may be argued that score on the professional examination is partially dependent upon experience and that length of service is therefore given added weight by heavily weighting the examination score. If this were true there should be a significant correlation between examination score and length of service. It was found that the correlation between the examination scores of the fifteen chief aviation machinist's mates and their years of total service was zero.

Effect of the Limitation on Length of Service

As stated previously, credit is given for not more than twenty years' service for advancement purposes. This is probably predicated on the assumption that the relationship between length of service and service worth may be nonlinear. It seems logical that early years of experience are the most valuable. For example, as a man progresses from one years' experience to five years' his value to the service should increase very rapidly but, after a certain point, each additional year of experience probably adds less and less to his service worth.

There is still another argument for limiting credit allowed for length of service. This is that if a man has a great deal more service than his competitors for promotion

it may be suspected that he is not particularly competent, else he would have been promoted previously. This reasoning is somewhat circular but it appears to have more merit than the theory of decreasing service worth with length of service.

While the present system has a limitation in theory, it does not operate in practice. As was seen in the case of the group studied, only one man was affected by the service limitation and he lost only the small amount of one-fourth year. Since the group's average service was greater than that of all chief petty officers in the Navy, it is reasonable to conclude that the length of service limitation has no practical effect on the promotion system at the present time.

Service in Present Rate

The service in rate of each member of the group studied is shown in Table VIII. The average service in rate was 6.69 years. The average for all chief petty officers in the Navy was not available for comparison but it is interesting to note the results of the December, 1948 examinations which showed that the average first class petty officer advanced to chief petty officer after approximately four and one-half years' service in grade.[1]

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[1] A. L. Gebelin, op. cit., p. 9.

TABLE VIII

COMPARISON OF RANK ORDER BY LENGTH OF SERVICE IN RATE WITH CRITERION RANK ORDER

Subject	Service in Rate Years	Rank Order	Criterion Rank
B	8.83	1	2
A	7.83	2	1
D	7.42	3	4
H	7.33	4.5	8
L	7.33	4.5	12
K	7.25	6	11
I	7.08	7	9
J	6.58	8.5	10
N	6.58	8.5	14
G	6.50	10	7
M	6.08	11	13
F	5.92	12	6
E	5.83	13	5
C	5.67	14	3
O	4.08	15	15

As might be expected, service in rate correlated highly (+.82) with total naval service and somewhat lower (+.34) with the criterion. Service in rate is a part of total service and both measure the same characteristic - probably experience. One cannot be separated from the other. It does not seem reasonable to give both factors weight in determining order of promotion. Although service in rate appears to be given weight in the Navy promotion system, the limitations placed upon it render it unimportant in practice.

Effect of the Limitations on Service in Rate

For purposes of promotion to chief petty officer rates, credit is allowed for a maximum of five years' service in

rate. Since a man must have three years' service as a first class petty officer before being eligible for advancement, the maximum credit differential for service in rate between any two competitors for promotion to chief petty officer is two years. However, the average man advanced to chief petty officer in 1948 had four and one-half years' service in rate which would make the credit differential between the long service man and the average only one-half year. The net effect of the limitation on service in rate, therefore, seems to be to nullify it insofar as advancement in rating to chief petty officer is concerned.

CHAPTER VII

OTHER FACTORS AFFECTING PROMOTION

Medals and Awards

The promotion system allows credit for twenty different medals and awards ranging from the Medal of Honor to the Navy Good Conduct Medal. Area campaign medals, victory medals, and similar awards are not included. With the exception of the Good Conduct Medal, credit is given only for awards for heroism or exceptionally meritorius service.

Each medal is assigned a point value according to its status but a candidate for promotion may claim a maximum of five points only, regardless of the number of awards he may have. A Medal of Honor is worth five points while a Good Conduct Medal is worth only one.

With the possible exception of those who have won medals, no one seriously believes that there is a positive relationship between awards and promotability. This belief is supported by the data presented in Table IX, page 52. The correlation between awards and the criterion was +.18 which is not significant.

There are two other important facts to be noted in the table. The first is that the median award score was three points; and the other is that the minimum award score was two points. Since credit for awards is limited to five

points, the maximum difference between any two of the men was three points and the difference between the maximum and median scores was two points. Two or three points are of relatively minor importance in the determination of the final order of promotion.

TABLE IX

AWARD SCORES[a] AND RANK ORDER OF FIFTEEN CHIEF AVIATION MACHINIST'S MATES

Subject	Award Score	Rank Order
O	17	1
E	14	2
B	6	3
A	4	5
F	4	5
I	4	5
D	3	10
G	3	10
H	3	10
J	3	10
L	3	10
M	3	10
N	3	10
C	2	14.5
K	2	14.5

a. Award scores are based on instructions contained in "Report of Examination for Advancement or Change in Rating," NavPers 624 (revised 8-49).

Test Battery Scores

Every Navy enlisted man is administered a basic battery of four aptitude tests: the general classification test which is an intelligence test designed to measure ability to

think, to learn, and to understand instructions; an arithmetic test designed to measure computational accuracy and ability to use numbers in practical problems; a clerical aptitude test designed to measure speed and accuracy in clerical work; and a mechanical test designed to measure potentiality for work of a mechanical nature and familiarity with mechanical and electrical principles and operations.

Although the test battery has not been validated for any criterion other than success in training schools, naval officers have been led to place an almost blind faith in the test battery scores as predictors of success on the job. Particular importance has been attached to a high general classification test score as the earmark of a man of superior ability. What most officers do not realize is that a high degree of intelligence may be nearly as undesirable as too low a degree, and that success in a great variety of occupations has no relationship to intelligence.

There is also a general belief that general classification test scores correlate significantly with professional examination grades. Some officers would go so far as to base promotions on intelligence test scores. The Navy has fallen victim to the greatest danger in psychological testing - overselling.

The data presented in Table X do not support the Navy's general beliefs. There is no significant correlation between any of the basic test battery scores and the criterion.

and, with the exception of the mechanical test, there is no significant correlation with the professional examination scores.

TABLE X

BASIC TEST BATTERY SCORES[a] OF FIFTEEN CHIEF AVIATION MACHINIST'S MATES

Subject	GCT	ARI	MECH	CLER	Criterion
A	50	41	55	56	1
B	68	68	63	51	2
C	53	64	67	58	3
D	72	60	60	55	4
E	54	54	56	57	5
F	60	44	59	56	6
G	48	41	57	52	7
H	67	60	57	52	8
I	49	57	55	63	9
J	52	45	59	46	10
K	57	54	57	55	11
L	52	45	59	46	12
M	52	58	60	58	13
N	60	64	64	63	14
O	57	67	48	42	15

a. Navy standard scores. Mean 50, standard deviation 10.

The correlation between mechanical test scores and professional examination scores was found to be +.48 which suggests that the two tests may, in part, be measuring the same thing. Unfortunately, this relationship must be viewed with suspicion because there is doubt whether the mechanical test scores of the men are comparable. In December, 1946 the "mechanical aptitude test" in the basic battery was replaced by the present "mechanical test." The scores of some of the men in the group are based on the old mechanical aptitude

test and some are based on the new mechanical test. Therefore, the correlation found between the mechanical test scores and the professional examination is valid only to the extent that the scores on the two mechanical tests are comparable.

Education

Years of education of the fifteen men ranged from eight to thirteen with a median of eleven. It is interesting that the five men ranked highest by the officers had a total of fifty-two years' education, the next five had a total of fifty-five years, and the low five had a total of fifty-six years. The only man with any college training was unanimously ranked lowest by the officers.

Age

The average age of the group was 34.8 years. The correlation between age and the criterion was +.46 and the correlation between age and length of service was +.62. While it is impossible to separate the factors of age and length of service, it seems obvious that the characteristic measured by length of service, whatever it may be, is important to promotability in the Navy.

CHAPTER VIII

ORDER OF PROMOTION

Multiple Computation

The promotion list for chief petty officers is established in the rank order of multiple scores computed as shown in Table XI.[1] The major criticism of the Navy promotion system is directed at the maximums shown in the third column.

TABLE XI

METHOD OF COMPUTATION OF MULTIPLE SCORES

Factors	Multipliers		Maximums
Professional Examination	Score (0 to 4) (2 decimals)	x 20.00	80.00
Total Naval Service	Years (2 decimals)	x 1.00	20.00
Service in Present Rate	Years (2 decimals)	x 1.00	5.00
Awards	Points	x 1.00	5.00
Final Multiple			110.00

Some critics of the system erroneously believe that these maximums represent the weights assigned to the several

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1. "Report of Examination for Advancement or Change in Rating," NavPers 624 (Revised 8-49).

factor. For example, it is the contention that since 80 is 73 per cent of 110, the weight of the professional examination is 73 per cent of the total multiple. This reasoning would be approximately correct if the maximums represented the actual ranges of the scores of the various factors.

Although the weighting of each of several combined measures is actually determined by their relative variances, an approximation of the weightings can be made if the range of each measure is known or can be estimated. For a large population, the range of the factors in the promotion multiple may be estimated as follows:

1. Professional examination. The minimum qualifying score is 2.50 and the maximum possible score is 4.0. The estimated range is 1.50.
2. Total naval service. The minimum service for eligibility for advancement to chief petty officer is six years and the maximum credit allowed is twenty years. The estimated range, therefore, is 14.
3. Service in rate. The minimum service in rate for advancement to chief petty officer is three years and the maximum credit allowed is five years. The estimated range is 2.
4. Awards. It may be assumed that any man otherwise eligible for advancement to chief petty officer would have earned at least one Good Conduct Medal which would give him a minimum award score of one

point. Since the maximum allowed is five points, the estimated range is 4.

Table XII shows the approximate weights of the factors in the promotion multiple computed using the estimated ranges. The per cents in column five represent the effects each factor could be expected to have on the final multiple scores if the system were applied to a population whose scores were distributed over the entire possible ranges.

TABLE XII

WEIGHTS OF FACTORS CONTRIBUTING TO PROMOTION MULTIPLE COMPUTED FROM ESTIMATED RANGES

1 Factor	2 Estimated Range	3 Multiplier	4 Multiple Range	5 Percent Weight
Professional Examination	1.5	20	30	60
Total Naval Service	14	1	14	28
Service in Present Rate	2	1	2	4
Awards	4	1	4	8
Totals			50	100

Multiple Scores

The multiple scores for the fifteen chief aviation machinist's mates are presented in Table XIII. The scores were computed using the formula explained in Table XI in which

the professional examination score is multiplied by twenty and the scores of all other factors are merely added.

TABLE XIII

RANK ORDER BY MULTIPLE SCORE OF FIFTEEN CHIEF AVIATION MACHINIST'S MATES

Subject	Prof. Exam.	Total Service	Service in Rate	Awards	Total	Rank Order
A	52.20	20.00	5.00	4.00	81.20	2
B	58.20	20.00	5.00	5.00	88.20	1
C	57.00	8.75	5.00	2.00	72.75	9
D	50.60	17.17	5.00	3.00	75.77	5
E	52.20	10.92	5.00	5.00	73.12	8
F	53.80	15.75	5.00	4.00	78.55	3
G	57.60	12.50	5.00	3.00	78.10	4
H	45.40	14.33	5.00	3.00	67.73	13
I	43.80	17.42	5.00	4.00	70.22	11
J	42.20	12.92	5.00	3.00	63.12	15
K	47.00	14.42	5.00	2.00	68.42	12
L	53.40	13.92	5.00	3.00	75.32	6
M	50.60	12.33	5.00	3.00	70.93	10
N	54.40	12.25	5.00	3.00	74.65	7
O	47.40	10.33	4.08	5.00	66.81	14

Weighting of Factors

The range of the several factors contributing to the multiple may be determined by a study of the above table. The ranges are important because they indicate the relative effect of each of the factors on the final multiple score. These ranges are:

Professional examination:	58.20	-	42.20	=	16.0
Total naval service:	20.00	-	8.75	=	11.25
Service in present rate:	5.00	-	4.08	=	0.92
Awards:	5.0	-	2.0	=	3.0
Totals	88.20	-	57.03	=	31.17

The amount which the range of a single factor contributes to the total range may be considered as the approximate weight of the factor in the multiple score. The per cent weights are:

Professional examination:	51 per cent
Total naval service:	36 per cent
Service in present rate:	3 per cent
Awards:	10 per cent
Total	100

Since only those men scoring 2.5 or higher on the professional examination are considered qualified for advancement, the weights of the factors should be computed from the ranges of the scores of the qualified men only, rather than from the total ranges. The scores of Chiefs H, I, J, K, and O should be eliminated from the computation since they have no effect on the final standings of the qualified candidates. The ranges and the per cent weights then become:

Professional examination:	58.20 - 50.60 = 7.60 = 35%
Total naval service	20.00 - 8.75 = 11.25 = 51%
Service in rate:	5.00 - 5.00 = 0.00 = 0%
Awards:	5.00 - 2.00 = 3.00 = 14%
Totals	88.20 - 66.35 = 21.85 = 100%

The effects of the various factors may be seen more readily in Table XIV which shows the changes in rank order for the ten qualifying men as each factor is added to the

multiple. Since service in present rate had no effect whatsoever, it has not been included in the table.

TABLE XIV

CHANGES IN RANK ORDER AS FACTORS ARE ADDED TO MULTIPLE

Subject	Rank Order Professional Examination	Rank after Total Naval Service Added	Rank after Award Score Added
A	7.5	2	2
B	1	1	1
C	3	8	9
D	9.5	5	5
E	7.5	9	8
F	5	4	3
G	2	3	4
L	6	6	6
M	9.5	10	10
N	4	7	7

Correlation with the Criterion

The final rank order of promotion of the chiefs, as determined by their multiple scores, is shown in the last column of Table XIII, page 59. The rank order correlation between the multiple scores and the criterion ranks was +.61. This correlation includes all fifteen men regardless of whether or not they attained the minimum passing score on the professional examination.

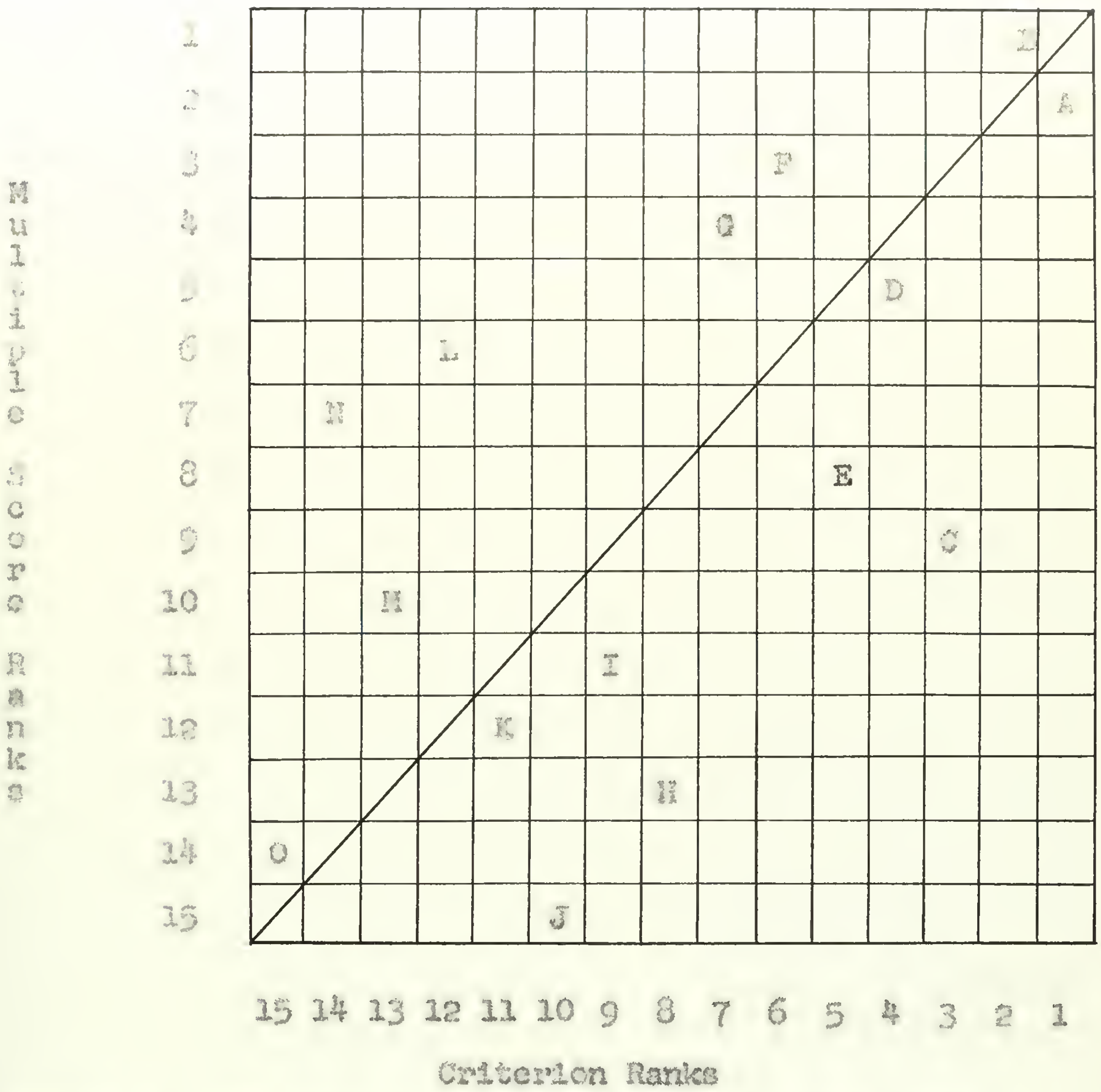

FIGURE 2. THE CRITERION VERSUS MULTIPLE SCORE RANKS

Efficiency of the Promotion System

The correlation coefficient of +.61 between the criterion and the multiple score ranks indicates that the Navy promotion system should be very useful in group prediction. Figure 2 shows that for small selection ratios[a] the system is very efficient.

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[a] The selection ratio is the ratio of the number to be promoted to the number of candidates for promotion.

For example, if three men were to be promoted the system would select A, B, and F, all of whom are in the high 40 per cent of the criterion. If five men were to be promoted - a selection ratio of .33 - all those selected would rank above the criterion median. If it were desired to promote all the above average men, seven would be chosen. The promotion system would select five high men and two from the low group, an efficiency of 71.5 per cent. Even if the selection ratio were increased to .60 (nine men to be promoted), the group selected would be composed of all the men above the criterion median plus two from the low group.

It is important to note that the promotion system does not seem to work in reverse. That is, while it is efficient in selecting the best men, it does not do an equally good job of rejecting the poorer ones. While the low group of five, according to the multiple ranks, consists entirely of men at or below the criterion median, only one man in the judges' low group of four is included.

CHAPTER IX

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The Problem. The problem was primarily concerned with the validity of the Navy promotion system. The study was undertaken to determine whether the promotion system was capable of selecting the best men for advancement. It was proposed to find the answers to three questions:

1. Does the Navy promotion system distinguish between the men who are qualified and those who are not?
2. Does the Navy promotion system establish the promotion list so that the best qualified men are advanced in rating first?
3. If the Navy promotion system does not now promote the best qualified men first, can the several factors affecting relative standing on the promotion list be re-weighted so that the best qualified men will be promoted first?

The Navy Promotion System. There are eight basic steps which every Navy man must complete prior to advancement in rating. These are:

1. Length of service.
2. Marks requirements.
3. Completion of training course.

4. Course at a service school.
5. Practical factors.
6. Recommendation by commanding officer.
7. Examination in military requirements.
8. Professional examination.

An analysis indicated that only two of these steps, length of service, and the professional examination had any real effect in determining standing on the promotion list. Promotions are also influenced somewhat by conduct.

The Method of Investigation. The study was limited to promotion to the rate of chief aviation machinist's mate. The basic program of investigation consisted of selecting a group of fifteen chief aviation machinist's mates and three officers qualified to judge the men on job performance and promotability. The criterion was the rank order-of-merit established by the judges. The men were given a professional examination and their scores were combined with length of service, service in rate, and awards to determine the order in which the Navy promotion system would have advanced them in rating.

In establishing the criterion by the consensus of judges' rankings, it was found that while the agreement among judges as to the actual rank order of the men was not high, the judges were in about 75 per cent agreement as to the men in the high, middle, and low groups.

The Professional Examination. The professional examination used in the study had been previously used in the Navy

service-wide competition in December, 1949. It was an objective type examination consisting of 150 multiple choice questions. Although the rank order correlation between the examination scores and the criterion was only +.38, all seven of the men above the criterion median passed the examination while only three of those below the median passed.

An item analysis of the examination questions indicated that the examination was subject to considerable improvement. Only about 27 per cent of the questions were at the proper level of difficulty for the group tested and only 53 per cent of the questions actually discriminated between the high and low test score groups. The reliability of the examination was found to be .70 which is barely acceptable.

Length of Service and Age. The length of service of the chief petty officers in the group ranged from 8.75 years to 20.25 years, averaging 14.2 years. The correlation between length of service and the criterion was found to be +.46 which was the highest correlation with promotability of any of the factors influencing order of promotion. Service in rate was found to correlate +.34 with the criterion but the limitations placed upon service in rate in the multiple computation render it unimportant in determining the order of promotion.

It was found that age correlated +.48 with the criterion and +.62 with length of service. This would seem to support the fact that length of service is more important to promotability in the Navy than has been thought in the past.

Medals and Awards. The correlation between awards and the criterion was found to be +.18 which is not statistically significant. However, the limitations placed upon the number of multiple points which may be claimed for awards reduce this factor to one of minor importance in the promotion system although awards for good conduct and heroism do have some effect in determining the order of promotion.

Test Battery Scores. With the exception of a +.48 correlation between the mechanical test and the professional examination scores, none of the basic test battery scores correlated significantly with either the criterion or the professional examination.

Selection Efficiency of the Promotion System. The rank order correlation between the multiple scores and the criterion was +.61. In the case of the group studied, if the selection ratio is kept small, the promotion system will select the better men for promotion with considerable accuracy. If the selection ratio is .33 or less, all those promoted would be from the above-median group of the criterion.

Although the system selects the top men with efficiency, it does not do an equally good job of rejecting the men in the lower range of the criterion. That is, the promotion system will select a small group of good men for advancement but it will not select a small group of poor men for demotion.

Weighting of Factors in the Promotion Multiple. The weighting of the several factors contributing to the promotion multiple depends almost entirely upon the scores of the group under consideration. By using estimated ranges to determine approximate weightings, it was shown that the professional examination and length of service could be expected to contribute 51 per cent and 36 per cent respectively to the final multiple. However, a study of the ten high multiple scores in the group showed that the professional examination contributed only 35 per cent to the multiple, while length of service contributed 51 per cent.

Conclusions

Limitations. In drawing conclusions from this study of the group of fifteen chief aviation machinist's mates certain limitations must be recognized. First, the group studied did not constitute a representative sample of chief aviation machinist's mates in the Navy and, second, the sample was very small. While the following conclusions apply specifically only to the group studied, the selectivity of the promotion system could be expected to increase if it were applied to a group with a wider range of talent. The findings of this study should be taken as evidence to be confirmed or refuted by further research.

Discrimination Between Qualified and Non-qualified Men. The first question to be answered was: Does the Navy promotion system distinguish between the men who are qualified

and those who are not? In the group studied only one man, Chief O, was considered by the judges not to be qualified as a chief petty officer. While the system can not be said to have definitely set him apart from the others, it did rank him as number fourteen in the group of fifteen. In addition, according to Navy standards, he failed the professional examination and would not have been promoted regardless of his multiple score.

Four other men, all considered qualified by the officers, also failed the examination. Although the five men designated as not qualified by the system all ranked at or below the criterion median, it does not appear that the promotion system, as it operates, distinguishes accurately between the qualified and the non-qualified. This is because the burden of determining qualification for promotion is placed on the last step of the system. If the promotion system were better administered only those qualified for promotion would be allowed to compete for advancement. The unqualified would be eliminated by a previous step.

Promotion in Order of Qualifications. The second question to be answered was: Does the Navy promotion system establish the promotion list so that the best qualified men are advanced in rating first? From the standpoint of the individual the answer seems to be no. The promotion system is not sufficiently valid to be used for individual prediction. But how does one determine who is the best man? It will be

recalled that the officers agreed only on groups, not on individual rankings.

From the standpoint of group selection, however, the system is very efficient in promoting the best qualified men so long as a reasonably small selection ratio is used. Compared with the selection procedures generally used in industry, the Navy promotion system is excellent.

Weighting of Factors in the Promotion Multiple. The third question to be answered concerned the possible re-weighting of the factors comprising the multiple so that the selectivity of the system might be improved. So long as the present scoring system is in use it will be impossible to predetermine the weights for the several factors because the weights are dependent upon the distribution of scores for the particular group in question. It would appear from their correlation coefficients that the most effective practical weights for the factors would be: length of service, including service in rate, 50 per cent; professional examination, 40 per cent; and awards, 10 per cent. In order to give predetermined weights to the factors, the use of standard scores is necessary.

Inadequacy of Navy Job Specifications. In analyzing the Navy promotion system, particularly in connection with establishing the criterion of promotability, it was evident that the Navy does not have adequate job specifications. A thorough job analysis must be the first step in setting up any system of personnel selection. It is understood that the

Navy is now undertaking a large scale scientific billet analysis. Until these studies are complete the recommendations of the classification officers who profess the ability to place, transfer, and promote personnel on the basis of matching skills against job requirements should be viewed with reservations.

Leadership. The most glaring deficiency of the Navy promotion system is that it does not take leadership into account. As it is designed, it appears that the promotion system for chief petty officers places too much emphasis on technical proficiency.

Importance of Length of Service. Probably the most important conclusion that can be drawn from the study of the group of chief aviation machinist's mates is that length of service, or seniority, is the best single measure of promotability. This is not to be construed as a recommendation for promotion by seniority alone but it may be construed as questioning the wisdom of those who would accomplish reduction in the number of chief petty officers in the Navy by forced retirement of the older men.

Professional Examination Construction. Although the item analysis of the professional examination was made with a very small sample, it is a forced conclusion that the examination was not well constructed.

Usefulness of the Navy Promotion System. As a final conclusion, it should be stated that while the promotion

system should be improved in certain respects, it is now a good group personnel selection system. Considering the complexity of the Navy's promotion problem, it does an excellent job.

Recommendations

Scientific Job Analysis. The Navy promotion system needs the firm foundation of an accurate and scientific job analysis. The work now being done in this area should be given the highest priority. It is important not only to promotions but to all phases of naval personnel administration.

Petty Officer Rating Scale. The Navy urgently needs a new rating system for evaluation of enlisted personnel. The Petty Officer Rating Scale used in this study has the characteristics of a good scale and should meet this need. However, no rating scale, no matter how well constructed, can be used successfully unless the rating officers are properly trained and indoctrinated with the importance of accurate ratings and know the men being rated.

Practical Factors. The usefulness of practical factors as they are presently administered is doubtful. As job analyses for the various rates are completed, the practical factors should be revised to insure that they are, in fact, practical, realistic, and pertinent.

Improvement of the Professional Examination. The professional examinations for advancement in rating should be improved in a technical sense. An item analysis should be

made before the examinations are released for service-wide competition.

Measurement of Leadership Abilities. A means should be devised to measure the leadership ability of prospective petty officers. The Navy recognizes the vital importance of leadership in its men but, at present, leadership plays no part in the promotion system except as it may be related to length of service and technical proficiency.

Suggestions for Further Research

Relationship Between Seniority and Service Worth. In many Navy ratings there is an excess of men in the chief petty officer grade. In order to keep promotion channels open it will be necessary to reduce these excesses in some manner. There seems to be a growing attitude in the Bureau of Naval Personnel that a desirable step in reducing the excess of chief petty officers would be the forced retirement of the older men - those with more than twenty years' service. The results of this study indicate, however, that there may be a high correlation between length of service and service worth. Therefore, before any action is taken to separate the senior men from the service, the relationship between seniority and value to the service should be definitely determined by further scientific research. It would be tragic, indeed, if the Navy lost its better men through action unsupported by readily obtained facts.

Effect of the Promotion System on Morale. It has been assumed that if the Navy promotion system selected men for advancement in their relative order of qualifications, it would be considered a good system. This may not be true. The effect of the promotion system on morale is certainly at least as important as its selection efficiency. It is believed that the most important research that could be undertaken in the field of Navy promotions would be a study of the attitudes of naval enlisted personnel toward the promotion system. As Yoder[1] says, "Unless existing provisions contribute to high morale, they are not satisfactory, no matter how detailed and carefully organized they may be."

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[1] Dale Yoder, Personnel Management and Industrial Relations, p. 471.

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